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# Planning a Nationwide High Speed Rail Freight and Passenger Network

George Haikalis[1], Member, ASCE

## Abstract

Planning for high speed rail networks is better done at the national level when considering widespread public benefits of these networks, and is essential when dealing with institutional issues that are national in scale. Incremental improvements to the nation's extensive resource of existing railways offers hope for early benefits of high speed rail, with speeds initially up to 125mph, while keeping options open for adding new links at much higher speed, and for emerging technologies like maglev. A 35,000 to 45,000 mile high speed rail freight and passenger network could be brought into being within a three to five year period, through a national initiative that considered the nation's freight and passenger railways as a unit.

## Introduction

Most of the recent planning activity for new high speed rail systems in the U.S. has focused on a few high volume corridors. The underlying rationale for these projects is that they would be for-profit commercial ventures. The planning emphasis has been on discovering air travel markets, where high fare surface competition could produce adequate revenues to offset the substantial cost of new very high speed, 150 to 250 mph, rail projects. Where studies have gone beyond a single corridor, the effort has been primarily to examine sets of promising city pair links and to consolidate them on a common map. True systems planning efforts have been very limited.

The reluctance to consider broader public benefits or to come to terms with the nation's privately-owned freight railway system, the natural host for incremental steps toward high speed rail, perhaps initially at 125 mph, were

[1]Transportation Consultant, One Washington Square Village, #5D, New York, NY 10012

understandable given the political climate of the recent past. However it is clear that the public is ready to consider longer term social, economic and environmental issues as it deals with transportation infrastructure renewal, which for the most part, is a public sector responsibility. New flexibility has been given to states and localities in allocating Federal surface transportation dollars between highways and urban transit. It is inconsistent to expect new high speed rail projects to pay their own way in this context.

<u>What public purpose for investing in high speed rail?</u>

98% of the nation's intercity passenger travel is by highway and air. Amtrak, Greyhound and number of smaller bus operations share the rest. Many critical links in the nation's air and highway system are overcrowded. New airports, and widened highways, are not easy to put into place given community disruption, noise and air quality concerns. And new high speed rail service may be a much more cost effective means of adding new intercity passenger capacity.

Perhaps a more important rational for public investment in high speed rail, though, is the need to reduce near total dependence on the air and auto modes. Only a little more than half of the nation's population can drive an auto. Many drivers lack the skill or the stamina to undertake long auto trips alone. A substantial number of travelers are uncomfortable flying, for medical or psychological reasons. For these populations high speed rail taps an unfulfilled travel need, with the potential for positive economic gains, like tourism.

As improved local transit systems become more of a reality in most major urban areas, in response to new flexibility in Federal transportation investment policies, the need for upgraded intercity public transport becomes important. A seamless network of local and intercity public transport could permit many households to maintain mobility while reducing the number of cars owned and operated. Consumer expenditures would then be redirected to other more productive uses, stimulating new economic growth.

A significant shift in travel, both local and intercity, from highway to urban and intercity transit would have substantial societal benefits. Pressure would be lessened on non-renewable resources like oil and minerals. Emissions would be reduced and air quality would improve. Deaths and injuries from traffic accidents would be cut. And an acceptable alternative to motor vehicle use, with its major contribution of carbon dioxide and other greenhouse gases, would become available to travelers as the U.S. attempts to reduce its top-heavy contribution to the global warming problem.

Introduction of improved high speed rail systems focused on the centers of older cities could breath new life into these declining areas. Well designed interfaces between local rail transit systems and high speed intercity rail systems could form the basis for major development nodes in center cities. Restoring transit supporting densities in cities would also allow these places to become more energy efficient and more socially acceptable, allowing them to better compete with auto-dominated suburban "edge cities".

Establishing a set of goals for planning high speed rail networks, based on these public purposes, is an important first step. Evaluating the success of substantial public investment in high speed rail in meeting these goals will be a difficult undertaking given the limited research activity in this field, in the U.S. Hopefully, some important lessons can be learned from abroad.

## Why a Nationwide Planning Effort for High Speed Rail?

Transportation infrastructure is a national concern. Air and highway programs have traditionally been led by national policy prerogatives. If the case for public encouragement of high speed intercity public transport investment can be made, then planning should occur on a national basis. For the interstate highway program it was fairly obvious that major routes should not stop at state lines. Similarly, from a practical standpoint, high speed rail corridor links of individual city-pairs would best come together in common urban terminals.

Research and development of new technology for high speed rail has already begun at the national level. New Federal transport legislation earmarks substantial funding for advancing maglev technology. As this research proceeds it will become apparent whether maglev produces substantial performance or cost gains over conventional high speed rail technology.

In the meantime existing rail freight and passenger lines can be adapted for higher speed service with some modest investment, permitting public benefits of improved intercity public transport to be gained in the shorter term. If maglev research does not produce the dramatic results sought, new investment in conventional very high speed rail projects can be added to the existing upgraded rail system.

A strong case for planning high speed rail at the national level can be made in dealing with incremental improvements. Amtrak is the nationally chartered and financed entity for intercity rail passenger service. The Northeast Corridor Improvement Program (NECIP) was a Federal effort. Despite significant movement toward deregulation the host freight railways are still subject to many Federal requirements including safety, railway labor rights, and residual regulation in non-competitive markets. Amtrak's 25 year agreement for operation over these railroads expires in 1996. The opportunity exists for a nationwide exploration of the future role of this substantial national resource - the freight and passenger railway network.

<u>What's Ahead for the Nation's Rail Freight Industry</u>?

"Deregulation" has been the key to profitability for the nation's privately owned freight railways. After a decade of bankruptcy, abandonment and near collapse in the 1970s, rail lines have been brought back to life, and many have been restored to excellent physical condition in the 1980s. One key to this success has been new flexibility in pricing. Only "captive" freight, where railroads are the dominant carrier, remains regulated. The railroads are free to negotiate profitable rates for freight that is truck-competitive.

The result has been a massive, cost-based contraction of the local rail freight network. Expensive to maintain sidings were taken out of service, where low volume shippers did not produce needed freight revenues. Branch lines were sold to regional carriers, that had more flexibility in dealing with high rail labor costs. Intermodal (piggyback) services were restructured to favor concentrated long haul markets, with fewer local access points.

While allowing the railroads to become profitable, deregulation has not been without some unfortunate consequences. Though overall ton-miles have grown somewhat, the rail system has become much more a wholesale than a retail operation. In urban areas this has meant even more local delivery is by truck than by rail. Carload freight is concentrated at larger shipping and distribution centers, often located in the suburbs where land is cheaper. Many industries that were dependent on low cost (cross subsidized) rail freight were forced out of business. Many of the older inner city factories, and remote rural industries, were declining in any event, and it is hard to measure the additional impact of deregulation. Furthermore, since new entry into a heavily capitalised industry like railroading is virtually impossible, deregulation has led to a dramatic lessening of competition amongst rail carriers. In several large metro areas only a single carrier dominates. At best, most markets have only two to three carriers. Whether this has produced significant ill effects is unknown, but it is clear that heavy truck traffic continues to grow with all its unpleasant impacts, while rail capacity is under-utilized.

Most of the productivity gains resulting from deregulation have been achieved. The outlook for continued profitability of some of the carriers is uncertain. Some railways are heavily leveraged with debt (junk bonds). Labor costs remain high and adequate funding for rail retirement has been questioned. While recent Federal legislation did not require expansion of very large combination trucks on all of the nation's highways, as the railways feared, states will continue to be pressured by trucking interests for this technology gain. In the longer term railways must find new ways to gain public support for this issue, and for more rational truck user fees that would come closer to covering the roadway damage caused by heavy trucks.

Deregulation has led to a consolidation of the nation's railways into seven large carriers, which account for more than four fifths of system revenues. This consolidation has occurred in an ad hoc manner, and has led to a somewhat haphazard downgrading and abandonment of many former mainlines. These activities remain under ICC control. Yet if there were a next round of consolidations, present policies would leave the Federal government in a reactive role, unable to guide the rationalization of one of the nation's irreplaceable assets - its railway network. A clear Federal policy about the future of the rail freight industry is needed.

<u>What Technology is Best for Upgrading High Speed Rail?</u>

Upgrading rail passenger service on the host freight railways requires some difficult technology choices. Sweeping aside institutional issues and looking at the nation's rail network as a single entity one would probably choose to concentrate slower moving, conventional heavy duty rail freight on selected mainlines as much as possible, and emphasize other lines for high speed passenger and intermodal freight. Recent experience on the Northeast Corridor suggest that this would improve maintainability, safety and reliability.

This approach would still mean that on most passenger oriented lines, some "captive" local freight traffic would remain. Track would have to be maintained to adequate standards for high speed passenger service while enduring occasional heavy freight loads. In the Northeast Corridor passenger train speeds of 125mph are permitted on track that also carries freight. Somewhat higher speeds might be allowed, based on experience overseas. The relationship between track standards and passenger train speeds need to be refined. Current FRA standards may be appropriate, but a better understanding of passenger comfort, safety and the dynamic profile of alternative passenger train equipment is needed.

The nation's rail lines were not laid out with high speed in mind. In difficult terrain routes that minimized grades or reduced construction costs were sought. Through the years, though, many major civil engineering works were undertaken to improve alignments. Nonetheless, high speed rail passenger service on these lines must negotiate curves at higher speeds than are now permitted. Low center of gravity, tilt body train technology offers some immediate gains. At some locations, higher amounts of superelevation might be allowed, particularly for lines that would carry little heavy duty freight. Over time, selected high volume routes with severe curves might be replaced with better alignments.

Another major handicap for incremental upgrading of the nation's freight lines for high speed passenger service is the large number of highway grade crossings. Adequate protection for motorists at most rural grade crossings can be achieved at relatively modest cost by using conventional short arm crossing gates. For many years grade crossings remained on the Northeast Corridor while 120mph service was operated. Early warning devices were added near these crossings to alert motorists. Grade crossing apparatus cannot protect a high speed train, and its passengers, from injury due to careless drivers, particularly operators of heavy trucks. However, devices that can detect stalled trucks, and video recording units that can be used to apprehend drivers that routinely ignore grade crossing warnings, offer some help in the short term. Traffic engineering considerations should lead to development of uniform national standards for acceptable speed through grade crossings, which could supplant often unreasonable local regulations.

Ideally, of course, full grade crossing elimination should be achieved. Strategies for investing in grade crossing separation projects, based on the goal of improved passenger train performance, are needed. Crossings where truck traffic is heavy, where awkward roadway geometry exists and where trains speeds are not curtailed for other reasons might be prime candidates. In some cases an entirely new grade separated alignment might be appropriate. Design standards, like grades and vertical curves, for low volume rural highway overpasses might be lessened to reduce cost.

The consequences of train operator failure increase with higher speed. Current U.S. practice is to require some backup to manual operator control at speeds of 80mph and above. A variety of cab signals and automatic train protection have been installed on U.S. railroads through the years. Some freight railroads retain these systems, because human failure can result in expensive accidents, hazardous material cleanup and litigation costs. New designs for automatic train control are needed. Less costly approaches, such as relying on dead reckoning that is based on on-board computers and digital radio communication, must be developed and applied uniformly to the nation's freight and passenger mainlines.

Most high speed passenger lines overseas are electrified. However, in the U.S. there is great reluctance to tax petroleum products at levels attained in other industrialized countries, and at the same time, energy conservation efforts directed at the U.S. electric utility industry have made new demands for electric power in the U.S. more expensive. Consequently the nation's freight railroads have not found it cost effective to electrify. The same would seem likely, at least initially, for an incremental upgrade of high speed rail passenger service in the U.S. The planned extension of electrification of the Northeast Corridor to Boston is an exception, perhaps justified by network considerations or as a means for gaining new U.S. experience in this field.

The most likely candidate for train propulsion at sustained high speeds of 125mph, in the U.S., is the gas turbine. The United Aircraft tilt body Turbotrain was an early pioneer in the application of this technology. Turbine-powered trains, of French design, are currently operated on Amtrak's Empire Corridor, in upstate New York. Republic Locomotive is developing an advanced gas turbine locomotive for use on non-electrified U.S. railroads. Advances in turbine power and efficiency, plus refinements in solid state power conditioning, suggest that a turbine-electric drive might be a good choice for incremental high speed rail systems.

Other train technology issues need to be addressed. Again, the UAC Turbotrain, designed and built in the U.S. over twenty years ago, might be a starting point for enhancement. It featured a very lightweight aluminum carbody of crashworthy design meeting U.S. safety standards, a low center of gravity, passive tiltbody, aerodynamic design and an extremely low power to weight ratio for fast acceleration and low energy consumption. Some of its features like single axle trucks, and articulated unit train design were not favored by U.S. railroads at the time. Yet articulated trains are the standard for the French TGV, and Spain's successful Talgo train features single axle trucks. Innovations such as these should be encouraged, if high speed rail is to be introduced incrementally in the U.S. at reasonable cost.

## <u>What Might a Nationwide Network Look Like?</u>

A broad range of high speed rail freight and passenger network options exist. A comprehensive analysis, with a good deal of technical input and a broad public outreach effort, would be needed to produce a national consensus on a plan. In order to identify some of the key issues that must be considered a "representative" plan is outlined in this paper.

Looking at the inventory of the nation's rail lines as a single national resource is important. At present the 150,000 or so miles of railroad are husbanded by a complex array of separate institutions. Perhaps a starting point would be to consider an alternative institutional arrangement where all of the nation's major railroads including Amtrak were merged into a single entity. A network of 35,000 to 45,000 miles of route would be selected as the "national high speed rail freight and passenger system", analogous to the interstate highway system. These routes would follow the busiest travel corridors, and would include large metro areas of some threshold population, say 250,000 persons or more. A few of these routes would stretch from coast to coast, accommodating some high speed passenger trains, but primarily carrying high speed intermodal freight trains. The network would reach 70 to 80% of the continental U.S. population. Smaller offline or bypassed communities would be served by dedicated intercity feeder bus.

The remaining 100,000 or so miles of rail line would become the heavy duty rail freight mainline and branchline network. In a few instances, where little redundancy exists in the U.S. network, critical rail links would serve a dual function, with high speed rail and heavy duty freight overlaid. Under a single ownership the remaining rail freight system could be consolidated and made more efficient. Railroad administrative staff could be streamlined. Concerns about competition, however, would remain. Current regulation, where rail is the dominant mode, would remain in effect. One approach to offering greater diversity for rail freight shippers is to allow additional operators "open access" to a commonly owned and maintained right of way. To some extent this already occurs where unit trains are owned and managed, if not actually operated, by major shippers.

The high speed freight and passenger network would be upgraded, on an incremental basis, to 125mph standards. A multi-year investment strategy would include restoration of missing links, special attention to low speed segments, selection of terminal location and host of other issues. The design of service patterns is also important. An interconnected network of fixed interval (perhaps bi-hourly) services, modeled after the German railways, might be appropriate for much of the Northeast, Midwest and South. Trains that serve chains of city pairs might be timed to connect with similar train services at critical hubs, with cross platform transfers. Long distance trains would be fitted into in these regular interval patterns. Under a unified management, and with an upgraded roadbed, a high level of punctuality for long distance trains would be possible. High speed overnight trains could continue as day trains serving a variety of travel markets, in an efficient manner. Sleeping compartments could double as daytime conference centers. High speed freight service on the network would consist of specially-designed high performance intermodal container trains that would be compatible with passenger trains.

It would be optimistic to anticipate that this restructured U.S. railway network could be self supporting without subsidies. In all likelihood, the high speed portion would need substantial public support for capital costs, particularly the highway grade crossing elimination efforts. However, the economies resulting from consolidation of existing rail freight carriers might well produce enough gains to make the whole enterprise break even, or work at a profit. Who knows? Hopefully, in the years ahead, we might be able to harness an enormous national asset -- our railroads.